

Multiple Flow Processes Accompanying a Dam-break Flood in a Small Upland Watershed, Centralia, Washington

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 94-4026



U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
GORDON P. EATON, Director

For additional information
write to :

John E. Costa
U.S. Geological Survey
5400 MacArthur Blvd.
Vancouver, WA 98661

Copies of this report can be
purchased from:

U.S. Geological Survey
Earth Science Information Center
Open-File Reports Section
Box 25286, MS 517
Denver Federal Center
Denver, CO 80225

CONTENTS

| | |
|--|----|
| Abstract | 1 |
| Introduction. | 1 |
| Purpose and Scope | 2 |
| Acknowledgments | 2 |
| Dam-failure Circumstances | 2 |
| Descriptions of Area | 5 |
| Geology | 5 |
| Valley and Flood-deposit Features | 5 |
| Evidence of Multiple Flow Processes | 7 |
| Morphology and Sedimentology of Deposits | 7 |
| Discharge Estimates | 10 |
| Flood and Debris-flow Hydrographs | 16 |
| Constructed-dam Failures | 17 |
| Conclusions | 17 |
| References Cited | 18 |

FIGURES

| | |
|---|----|
| 1. Location map of Centralia, Wash. and water-supply reservoirs that failed on Oct. 5, 1991 | 2 |
| 2. Aerial photograph of failed reservoir | 3 |
| 3. Geologic section of the area down-slope of Reservoir Number 3 | 3 |
| 4. Photograph of the hillslope below Reservoir Number 3 that has been washed and eroded by overland flow | 4 |
| 5. Topographic map of the slide block and slope-area reach below Reservoir Number 3 | 6 |
| 6. Photograph of massive gravel deposit upstream of the slope-area reach | 7 |
| 7. Photograph of debris-flow sediments deposited on the right side of the floodplain near cross section 4 | 8 |
| 8. Mechanical analysis of debris-flow deposits shown in Fig. 7 and source-area gravel fill | 8 |
| 9. Photograph of a boulder levee washed of fines along the left valley wall between cross-sections 2 and 3 | 9 |
| 10. Photograph of glass beer bottle (unbroken) deposited with debris flow sediments Location plotted on Fig. 5 | 10 |
| 11. Photograph of the floodplain in the slope-area reach | 11 |
| 12a-b. Cross sections used in determination of peak discharge. Cross-section 1 is upstream-most cross section | 12 |
| 13a-b. Photographs of cross-sections 2 and 4 used in the slope-area analysis | 13 |
| 14. Total energy-diagram for the peak-water flood | 14 |
| 15. Reconstructed hydrographs of the Centralia debris flow and water-flood | 15 |
| 16. Potential energy as a function of peak discharge for constructed dams. Envelope curve is defined by the French Malpasset Dam failure, the Buffalo Creek, W. Va. coal-spoil dam failure and the Centralia, Wash. reservoir failure | 16 |

TABLE

| | |
|--|----|
| 1. Hydraulic data for Centralia, Wash. dam-failure flood of Oct. 5, 1991 | 10 |
|--|----|

CONVERSION FACTORS AND VERTICAL DATUM

| Multiply | By | To obtain |
|------------------------|-------|-----------------------|
| millimeter | 0.039 | inch |
| meter | 3.28 | foot |
| kilometer | 0.62 | mile |
| cubic meter | 35.3 | cubic foot |
| meter per second | 3.28 | foot per second |
| cubic meter per second | 35.3 | cubic foot per second |

Sea level: In this report “sea level” refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.